OIPE IAP88 FEB 24 2006 PATENT & TRADEMARK OFFICE

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re U.S. Patent Application of
HOSOKAWA et al.
Application Number: 10/727,601
Filed: December 5, 2003
For: SWITCHING POWER SUPPLY DEVICE AND THE SEMICONDUCTOR INTEGRATED CIRCUIT FOR POWER SUPPLY CONTROL

ATTORNEY DOCKET NO. HITA.0468

Art Unit 2838

Examiner: A. D. Berhane

Commissioner of Patents
P.O. Box 1450
Alexandria, VA 22313-1450

COVER LETTER

Sir:

[x] The fee for submission of claims is calculated as shown below:

FOR	TOTAL WITH NEW CLAIMS ADDED	TOTAL CURRENTLY ON FILE	CLAIMS ALREADY PAID	RATE	CALCULATION
Total Claims	20	20	(Over 20)	x $50	0
Independent Claims	5	5	2 (Over 3)	x $200	00
MULTIPLE DEPENDENT CLAIM(S)				+ $360	0
REDUCTION FOR FILING BY SMALL ENTITY (note 37 C.F.R. §§ 1.9, 1.27, 1.28). IF APPLICABLE, VERIFIED STATEMENT MUST BE ATTACHED					
			TOTAL		0

In addition, the below-identified communications are submitted in the above-captioned application or proceeding:

[x] Supplemental Response to Office Action (with claim amendments)
[ ] Substitute Abstract
[ ] Preliminary Amendment
[ ] Other_____________________
[ ] Petition for __ month Extension-of-Time
[ ] Terminal Disclaimer
[ ] Sequence Listing Statement
[ ] Sequence Listing
[ ] Sequence Listing Diskette______

[ ] Please charge my **Deposit Account Number** in the amount of ____ to cover the fees for __________________. A duplicate copy of this paper is enclosed.

[ ] A check in the amount of $ to cover the fee is enclosed.

[x] The Commissioner is hereby authorized to charge any additional fees associated with this communication, or credit any overpayment to **Deposit Account Number 08-1480**.

Respectfully submitted,

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February 24, 2006

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In re U.S. Patent Application of	)	
HOSOKAWA et al.	)	**Unit 2838**
Application Number: 10/727,601	)	**Examiner Berhane, Adolf D.**
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For: SWITCHING POWER SUPPLY DEVICE AND THE SEMICONDUCTOR INTEGRATED CIRCUIT FOR POWER SUPPLY CONTROL	)	
ATTORNEY DOCKET NO. HITA.0468	)	

Honorable Assistant Commissioner
for Patents
Washington, D.C. 20231

SUPPLEMENTAL RESPONSE

Sir:

This is supplemental to the response filed on February 23, 2006. Please further amend the above-referenced application as follows:

IN THE CLAIMS:

Please amend claims 1 and 10-11 as follows:

1. (Currently Amended) A semiconductor integrated circuit for power supply control for performing switching control of a switching power supply device which switches currents flowing through a primary coil of a transformer for voltage conversion to drive the primary coil with alternate currents and rectifies currents flowing through a secondary coil of the transformer to output DC voltages,

    wherein the semiconductor integrated circuit generates and outputs a signal for dynamically controlling off-timings of a transistor for synchronous rectification at the secondary coil in accordance with at least one of an input voltage of the primary coil and a load current of the secondary coil to turn off the transistor immediately before inverting a current direction flowing through the primary coil so as to minimize switching power losses.

2. (Original) The semiconductor integrated circuit for power supply control according to claim 1,

    wherein the semiconductor integrated circuit generates and outputs a signal to dynamically control on-timings of a switching element for switching currents flowing through the primary coil in accordance with input voltages of the primary coil.

3. (Original) The semiconductor integrated circuit for power supply control according to claim 1,

    wherein the semiconductor integrated circuit generates and outputs a signal to dynamically control on-timings of a switching element for switching currents flowing through the primary coil in accordance with load currents at the secondary side.

4. (Original) The semiconductor integrated circuit for power supply control according to claim 1,

    wherein the semiconductor integrated circuit generates and outputs a signal to dynamically control on-timings of a switching element for switching currents flowing through the primary coil in accordance with input voltages of the primary coil and load currents at the secondary side.

5. (Original) The semiconductor integrated circuit for power supply control according to claim 1,

wherein the semiconductor integrated circuit generates and outputs a control signal by turning on or off a first synchronous rectification transistor and a second synchronous rectification transistor,

the first synchronous rectification transistor being connected between one terminal of the secondary coil and a reference potential point and turned on or off in synchronization with a switching operation for switching currents flowing through the primary coil, and

the second synchronous rectification transistor being connected between the other terminal of the secondary coil and the reference potential point and turned on or off in synchronization with the switching operation at the primary side.

6. (Previously Presented) A semiconductor integrated circuit for power supply control for performing switching control of a switching power supply device which switches currents flowing through a primary coil of a transformer for voltage conversion to drive the primary coil with alternate currents and rectifies currents flowing through a secondary coil of the transformer to output DC voltages, comprising:

a first control signal generation circuit to generate a control signal used for switching currents flowing through the primary coil;

a second control signal generation circuit to generate control signals for the first and second synchronous rectification transistors at the secondary side based on a signal generated by the first control signal generation circuit;

a variable delay circuit capable of supplying any delay to control signals generated by the first and second control signal generation circuits;

an external terminal to input setup information for specifying a delay amount supplied by the variable delay circuit;

a delay amount control circuit to generate, based on setup information from the external terminal, a signal for controlling a delay amount in the variable delay circuit; and

a nullification means for nullifying delay amount control by the delay amount control circuit,

wherein the semiconductor integrated circuit generates and outputs a signal for dynamically controlling off-timings of a transistor for synchronous rectification at the secondary coil in accordance with at least one of an input voltage of the primary coil and a load current of the secondary coil,

the semiconductor integrated circuit generates and outputs a control signal by turning on or off a first synchronous rectification transistor and a second synchronous rectification transistor,

the first synchronous rectification transistor being connected between one terminal of the secondary coil and a reference potential point and turned on or off in synchronization with a switching operation for switching currents flowing through the primary coil,

the second synchronous rectification transistor being connected between the other terminal of the secondary coil and the reference potential point and turned on or off in synchronization with the switching operation at the primary side, and

the nullification means nullifies operations of the delay amount control circuit in accordance with a state of the external terminal.

7. (Original) The semiconductor integrated circuit for power supply control according to claim 6, comprising:

a detection means for detecting whether or not the load current goes below a specified value,

wherein, when the load current goes below a specified value, the variable delay circuit is changed to supply no delay to off-timings of the control signal for the first and second synchronous rectification transistors.

8. (Original) The semiconductor integrated circuit for power supply control according to claim 1, comprising:

a voltage monitoring means for detecting a level of the primary input voltage and, when the input voltage reaches a specified level, stops supplying power to an internal circuit,

wherein an input terminal for voltages monitored by the voltage monitoring means is also used as an input terminal for voltages of the primary coil which is monitored to control on-timings of the switching element for switching currents

flowing through the primary coil.

9. (Original) The semiconductor integrated circuit for power supply control according to claim 6,

wherein information about load currents input to the first control signal generation circuit and information about load currents input to the delay amount control circuit are input from the same external terminal.

10. (Currently Amended) A semiconductor integrated circuit for power supply control for performing switching control of a switching power supply device which switches currents flowing through a primary coil of a transformer for voltage conversion to drive the primary coil with alternate currents and rectifies currents flowing through a secondary coil of the transformer to output DC voltages,

wherein the semiconductor integrated circuit is configured to selectively set any detection criterion level for a circuit to generate a signal which detects a voltage between terminals of a switching element in a circuit for switching currents flowing through the primary coil and controls on-timings of the switching element at time points when a terminal voltage of the primary coil becomes minimum so as to minimize switching power losses.

11. (Currently Amended) A switching power supply device comprising:

a semiconductor integrated circuit for power supply control for performing switching control of a switching power supply device which switches currents flowing through a primary coil of a transformer for voltage conversion to drive the primary coil with alternate currents and rectifies currents flowing through a secondary coil of the transformer to output DC voltages, wherein the semiconductor integrated circuit generates and outputs a signal for dynamically controlling off-timings of a transistor for synchronous rectification at the secondary coil in accordance with at least one of an input voltage of the primary coil and a load current of the secondary coil to turn off the transistor immediately before inverting a current direction flowing through the primary coil so as to minimize switching power losses.

a transformer for voltage conversion;

a switching circuit which switches currents flowing through the primary coil

of the transformer for voltage conversion to drive the primary coil with alternate currents;

a rectifier circuit including a synchronous rectification transistor and rectifies currents flowing through a secondary coil to output DC voltages, the synchronous rectification transistor being connected between one terminal of the secondary coil of the transformer for voltage conversion and a reference potential terminal and turned on or off in synchronization with switching operations of the switching circuit; and

a capacitor element for smoothing voltages rectified by the rectifier circuit,

wherein an input voltage to the primary coil is divided by resistors and is supplied to the semiconductor integrated circuit for power supply control.

12. (Previously Presented) A switching power supply device according to claim 11,

wherein the semiconductor integrated circuit generates and outputs a signal to dynamically control on-timings of a switching element for switching currents flowing through the primary coil in accordance with input voltages of the primary coil.

13. (Previously Presented) A switching power supply device according to claim 11,

wherein the semiconductor integrated circuit generates and outputs a signal to dynamically control on-timings of a switching element for switching currents flowing through the primary coil in accordance with load currents at the secondary side.

14. (Previously Presented) A switching power supply device according to claim 11,

wherein the semiconductor integrated circuit generates and outputs a signal to dynamically control on-timings of a switching element for switching currents flowing through the primary coil in accordance with input voltages of the primary coil and load currents at the secondary side.

15. (Previously Presented) A switching power supply device according to claim 11,

wherein the semiconductor integrated circuit generates and outputs a control signal by turning on or off a first synchronous rectification transistor and a second synchronous rectification transistor,

the first synchronous rectification transistor being connected between one terminal of the secondary coil and a reference potential point and turned on or off in

synchronization with a switching operation for switching currents flowing through the primary coil, and

the second synchronous rectification transistor being connected between the other terminal of the secondary coil and the reference potential point and turned on or off in synchronization with the switching operation at the primary side.

16. (Previously Presented) A switching power supply device, comprising:

a semiconductor integrated circuit for power supply control for performing switching control of a switching power supply device which switches currents flowing through a primary coil of a transformer for voltage conversion to drive the primary coil with alternate currents and rectifies currents flowing through a secondary coil of the transformer to output DC voltages, wherein the semiconductor integrated circuit generates and outputs a signal for dynamically controlling off-timings of a transistor for synchronous rectification at the secondary coil in accordance with at least one of an input voltage of the primary coil and a load current of the secondary coil;

a transformer for voltage conversion;

a switching circuit which switches currents flowing through the primary coil of the transformer for voltage conversion to drive the primary coil with alternate currents;

a rectifier circuit including a synchronous rectification transistor and rectifies currents flowing through a secondary coil to output DC voltages, the synchronous rectification transistor being connected between one terminal of the secondary coil of the transformer for voltage conversion and a reference potential terminal and turned on or off in synchronization with switching operations of the switching circuit;

a capacitor element for smoothing voltages rectified by the rectifier circuit;

a first control signal generation circuit to generate a control signal used for switching currents flowing through the primary coil;

a second control signal generation circuit to generate control signals for the first and second synchronous rectification transistors at the secondary side based on a signal generated by the first control signal generation circuit;

a variable delay circuit capable of supplying any delay to control signals generated by the first and second control signal generation circuits;

an external terminal to input setup information for specifying a delay amount supplied by the variable delay circuit;

a delay amount control circuit to generate, based on setup information from the external terminal, a signal for controlling a delay amount in the variable delay circuit; and

a nullification means for nullifying delay amount control by the delay amount control circuit,

wherein an input voltage to the primary coil is divided by resistors and is supplied to the semiconductor integrated circuit for power supply control, and

the nullification means nullifies operations of the delay amount control circuit in accordance with a state of the external terminal.

17. (Previously Presented) A switching power supply device according to claim 11,

a detection means for detecting whether or not the load current goes below a specified value,

wherein, when the load current goes below a specified value, the variable delay circuit is changed to supply no delay to off-timings of the control signal for the first and second synchronous rectification transistors.

18. (Previously Presented) A switching power supply device according to claim 11,

a voltage monitoring means for detecting a level of the primary input voltage and, when the input voltage reaches a specified level, stops supplying power to an internal circuit,

wherein an input terminal for voltages monitored by the voltage monitoring means is also used as an input terminal for voltages of the primary coil which is monitored to control on-timings of the switching element for switching currents flowing through the primary coil.

19. (Previously Presented) A switching power supply device according to claim 11,

wherein information about load currents input to the first control signal generation circuit and information about load currents input to the delay amount control circuit are input from the same external terminal.

20. (Previously Presented) A switching power supply device according to claim 11,

wherein the semiconductor integrated circuit is configured to be able to set any detection criterion level for a circuit to generate a signal which detects a voltage between terminals of a switching element in a circuit for switching currents flowing through the primary coil and controls on-timings.

REMARKS

The above amendments to the above-captioned application is supplemental to the response filed on February 23, 2006. In view of the above amendments and the following remarks, the Examiner is respectfully requested to give due reconsideration to this application, to indicate the allowability of the claims, and to pass this case to issue.

Status of the Claims

Claims 1-20 are under consideration in this application. Claims 1 and 10-11 are being amended, as set forth in the above marked-up presentation of the claim amendments, in order to more particularly define and distinctly claim applicants' invention.

All the amendments to the specification and the claims are supported by the specification. Applicants hereby submit that no new matter is being introduced into the application through the submission of this response.

Prior Art Rejections

Claims 1-5, 7-8, 10-15 and 17-20 were rejected under 35 U.S.C. § 102(a) as being anticipated by US Patent No. 6,504,739 to Phadke (hereinafter "Phadke"). Other references were cited as pertinent to the application. The above rejection has been carefully considered, but is most respectfully traversed.

The semiconductor integrated circuit of the invention for power supply control performs switching control of a switching power supply device which switches currents flowing through a primary coil of a transformer TS1 for voltage conversion to drive the primary coil with alternate currents and rectifies currents flowing through a secondary coil of the transformer to output DC voltages.

The semiconductor integrated circuit (for example, the 2nd embodiment depicted in Figs. 1 3-4, 9; pp. 11-24), as now recited in claim 1, generates and outputs a signal AD3 for dynamically controlling off-timings of a transistor (e.g., M6 or SF, p. 23, last paragraph) for synchronous rectification at the secondary coil in accordance with at least one of an input voltage Vin of the primary coil and a load current Iout of the secondary coil to turn off the transistor M6 immediately before inverting a current direction flowing through the primary coil Vsec 0. ("*It is most desirable to turn off the switch SF at the timing t5 immediately before the timing t6 that inverts the direction of the current flowing through the coil.*" p. 23, last 4

lines; Fig. 4) so as to minimize switching power losses (p. 3, line 2).

The invention of claim 11 is directed to a switching power supply device comprising: the semiconductor integrated circuit of claim 1; a transformer for voltage conversion; a switching circuit which switches currents flowing through the primary coil of the transformer for voltage conversion to drive the primary coil with alternate currents; a rectifier circuit including a synchronous rectification transistor and rectifies currents flowing through a secondary coil to output DC voltages, the synchronous rectification transistor being connected between one terminal of the secondary coil of the transformer for voltage conversion and a reference potential terminal and turned on or off in synchronization with switching operations of the switching circuit; and a capacitor element for smoothing voltages rectified by the rectifier circuit. An input voltage to the primary coil is divided by resistors and is supplied to the semiconductor integrated circuit for power supply control.

The invention recited in the claims 1 and 11 reduces power losses at a secondary side for the secondary coil, by the transistor being turned off at the optimal timing in accordance with changes in load currents at the secondary side or the input voltage of the primary coil (p. 5, 2nd paragraph; p. 6, last 2 paragraphs; p. 24, last paragraph).

In particular, "*during the period #5, the switches SB and SC turn off and the switches SA and SD turn on in the switching circuit at the primary side as shown in FIG. 9. This inverts the direction of current flowing through the primary and secondary coils of the transformer. However, the current direction does not invert yet immediately after the switch SB turns on. If the switch SF at the secondary side turns off, a loss occurs in the SF's body diode. If a delay occurs in the timing to turn off the switch SF, the secondary coil is short-circuited even if the primary coil is activated* (p. 23, last paragraph). ... *During the period #6 after the switch SF turns off, the input voltage -Vin is applied to the primary coil of the transformer TS1. The primary coil is supplied with a current having the direction reverse to that in FIG. 5. The power is transmitted from the primary side to the secondary side. Since SE turns on and SF turns off in the rectifier circuit at the secondary side, the current flows from the choke coil L2 to the load RL and then to the switch SE to store energy in L2* (p. 24, 2nd paragraph)."

The semiconductor integrated circuit (for example, the 2nd embodiment depicted in Fig. 15 & Figs. 16(3)-(4); pp. 34-39), as now recited in claim 10, is configured to selectively set any detection criterion level VBS (Fig. 15) for a circuit to generate a signal (e.g., OUT-B) which detects a voltage between terminals of a switching element (e.g., M2) in a circuit for

switching currents flowing through the primary coil and controls on-timings of the switching element M2 at time points when a terminal voltage of the primary coil becomes minimum ("*The MOSFET M2 shifts from the off-state to the on-state at the time point when the coil's terminal voltage V11 becomes minimum (0 V)*" p. 37, lines 16-17; Fig. 16) so as to minimize switching power losses (p. 37, last line).

The invention recited in the claim 10 reduces power losses of a primary side for the primary coil by being able to set any detection criterion level (p.5, 3rd paragraph; p. 7, 2nd & 3rd paragraphs).

Applicants contend that Phadke fails to teach or suggest (1) "generating and outputting a signal AD3 for dynamically controlling off-timings of a transistor for synchronous rectification at the secondary coil in accordance with at least one of an input voltage Vin of the primary coil and a load current Iout of the secondary coil to turn off the transistor immediately before inverting a current direction flowing through the primary coil" (Claims 1 and 11); or (2) "selectively setting any detection criterion level for a circuit to generate a signal which detects a voltage between terminals of a switching element in a circuit for switching currents flowing through the primary coil and controls on-timings of the switching element at time points when a terminal voltage of the primary coil becomes minimum" (Claim 10) so as to minimize switching power losses according to the invention.

In contrast, Phadke merely drives both synchronous rectifiers Q1, Q2 to an on state during a dead time period of operation. The onset of the dead time period occurs when the diagonal conducting switching device is driven to an off state, and drives the second of the two synchronous rectifiers Q2 to an on state only after one of the diagonal switching devices has been driven to an off state by the primary control circuit, so as to eliminate the risk of cross conduction between the synchronous rectifiers (Abstract), rather than to minimize switching power losses as does the invention.

Phadke (Fig. 5) simply does not (1) "turn off the transistor Q1 or Q2 for synchronous rectification at the secondary coil immediately before inverting a current direction flowing through the primary coil"; or (2) "control on-timings of the switching element QA, QB, QC, or QD in a circuit for switching currents flowing through the primary coil at time points when a terminal voltage of the primary coil becomes minimum" so as to minimize switching power losses

Applicants contend that the cited references or their combinations fail to teach or disclose each and every feature of the present invention as disclosed in the independent

claims 1 and 10-11. As such, the present invention as now claimed is distinguishable and thereby allowable over the rejections raised in the Office Action. The withdrawal of the outstanding prior art rejections is in order, and is respectfully solicited.

Conclusion

In view of all the above, clear and distinct differences as discussed exist between the present invention as now claimed and the prior art reference upon which the rejections in the Office Action rely, Applicants respectfully contend that the prior art references cannot anticipate the present invention or render the present invention obvious. Rather, the present invention as a whole is distinguishable, and thereby allowable over the prior art.

Favorable reconsideration of this application is respectfully solicited. Should there be any outstanding issues requiring discussion that would further the prosecution and allowance of the above-captioned application, the Examiner is invited to contact the Applicants' undersigned representative at the address and phone number indicated below.

Respectfully submitted,

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